

THE OBSERVER

East Valley Astronomy Club

From the Desk of the President by David Douglass

Wow! It is already the end of March, and 2009 is a quarter over. Time really does go by fast when you are having fun. As I write this article, my plans are complete for the All Arizona Messier Marathon, and I am looking forward to being at the Farnsworth property this weekend with all the other participants, and enjoying what promises to be a great weekend. The weather this past week has been a challenge, with many observing groups cancelling their scheduled outings. But the extended forecast for the marathon is looking good. We shall see.

As we enter the spring sea-

son, sunset times continue to get later and later. It becomes harder for schools to plan star parties, and that is reflected in our schedule for April. At this writing, five (5) school events are planned, and one of them is a day time function. There will be two (2) sidewalk astronomy events at the Riparian this month. The Special sidewalk astronomy event on Saturday, April 4th is part of the International "100 Hours of Astronomy". There will be considerable advance press notification about this via the Riparian newsletter, the Gilbert Republic, and the East Valley Tribune. When

this happens, we usually have a very good turnout. I hope you will consider bringing a telescope out, and participating at this event, as well as the usual public star party on Friday, April 10th. It continues to amaze me how many people read about these events, and come out to the Riparian to see the stars. The people of Gilbert, and surrounding areas, are very proud of the GRCO operations, and the monthly sidewalk astronomy sessions, as well as the monthly Skywatch talks. And EVAC is a very large part of all that.

A spe- *Continued on page 12*

The Backyard Astronomer

Stars Over Costa Rica by Bill Dellings

I last saw the southern hemisphere constellations twenty-three years ago on a Halley's Comet tour to Australia. However, I have since "disremembered" what I saw down under. I had a desire to take another look at those southern sky goodies and noted with interest the Sky and Telescope's 6th annual Costa Rica Southern-Sky Fiesta tour scheduled for February 21-28, 2009. Sky and Telescope uses TravelQuest (<http://onlinetravelquest.com>) for its tours.

I booked two spots for my wife Lora and me. The tour's advantages (compared to a longer trip below the equator) would be price and travel time. Its disadvantage would be that while still able to see the southern sky's main attractions, they would be relatively low over the south-

ern horizon. How low? The declination of -60 degrees runs through the Eta Carinae Nebula, the Southern Cross, and Alpha Centauri, prime real estate that interested me. The latitude of our observing site 65 miles northwest of San Jose was +10 degrees. Thus, our "prime real estate" would pass no higher than 20 degrees above the southern horizon as it passed the meridian. The globular cluster Omega Centauri (Dec -47) would fair slightly better with a height of 33 degrees. The South Celestial Pole would be 10 degrees below the horizon - there would be no circumpolar constellations. While this concerned me somewhat, I was encouraged by the popularity of this tour which had drawn enough stargazers to keep it going for 6 years.

For observing equip-

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Upcoming Events:

Public Star Party - April 10

Monthly General Meeting - April 17

Local Star Party - April 18

Deep Sky Star Party - April 25

Check out all of the upcoming club events in the Calendars on page 8

The Backyard Astronomer

Continued from page 1 ment, I brought my Televue 85mm F7 refractor and 8x50 binoculars. I could easily sling the TV85 in its soft bag over my shoulder as carry-on. The alt-az tripod was checked in a hard case. I knew going in I wanted large fields for open clusters, nebulae, and Milky Way star fields. The TV85 would prove to be an excellent choice for observing these types of objects.

I was pleased to find that US Airways operated a non-stop flight from Phoenix to San Jose, Costa Rica. That made it a simple task

to rendezvous with the other 28 participants in the tour group. Gary Seronik, who writes binocular and telescope-making articles in *Sky and Telescope* magazine, was our stargazing leader and is very knowledgeable about the night sky. Gary is an affable fellow who guided the group through the wonders of the southern night sky with a series of lectures highlighting the constellations and deep sky objects to be found in the

evening and early morning sectors of the February skies. Staying up all night in February allows one to see the very best the southern Milky Way offers.

La Ensenada Lodge rests along the Gulf of Nicoya on the west coast of Costa Rica. During the week of stargazing, the tour group had exclusive access to the facility. Red lights were temporarily installed throughout the rooms and grounds. The rooms were rustic but comfortable and without phones, television or air conditioning (windows on three sides of each room can be opened to create a cooling breeze). Each porch had a hammock. I tried mine on our last day and wished I had discovered it earlier! It was like being in the womb again! During the day it was hot and humid, less so at night. The lodge's pool gave guests a chance to cool off. Mosquitoes were out at night - repellent is highly recommended. Facing south, the rooms overlooked an expansive lawn with a very low southern horizon - just what the doctor ordered. Most of us set up our scopes on the lawn just outside our rooms, a nice convenience. Four out of our five nights were clear. Telescopes ranged from small refractors like mine, to mid-size Newtonians, a C6, C8, Gary's 12.75" travel scope, and a 15" Obsession, the biggest telescope there. The skies were fairly dark (dark sky meters registered 21.85 and 21.75 north of the zenith at midnight) with just a hint of sky glow in the southeast from Puntarenas. I had made a list of objects I wanted to observe before leaving on the trip. Gary also had sent us star maps loaded with deep sky objects and their data. At dusk Sirius and Canopus were approaching the meridian

allowing me to view many open clusters (OC) in Canis Major, Puppis and Vela. To the west I was able to trace Eridanus all the way down to Achernar. I had hoped to explore the Large Magellanic Cloud with my telescope but it was too low, only about 5 to 10 degrees above the southern horizon. I could barely make it out naked eye.

At midnight the Eta Carinae Nebula (the "Keyhole Nebula", NGC 3372) was on the meridian. This object is the Crown jewel

of the Southern Hemisphere in my opinion. This immense emission nebula spans two degrees, is divided by three prominent dark lanes and smothered in Milky Way stars. In the TV85 with an Ethos eyepiece (46x, 2 degree field) I found it hard to take my eye away from it and kept going back to view it again and again during the week - a fascinating object indeed. After a few nights of familiarizing myself with the many OC's in



Eta Carina nebula and Southern Cross above the gulf. Photo courtesy of John McDonald ©2009

Carina, I realized there were four "showpiece" clusters surrounding the Keyhole Nebula. Two degrees northwest is NGC 3293, the "Diamond and Ruby Cluster", a small and dainty OC similar to the Jewel Box cluster in Crux. Five degrees west is NGC 3114, which Gary called the Spider Cluster. I saw its streams of stars in the shape of a spiral galaxy. It was resolvable in 8x50 binoculars. Due south five degrees is IC 2602, the "Southern Pleiades." Like its namesake, I thought it looked best in binoculars but didn't think it was as pretty as its northern counterpart. Three degrees northeast is NGC 3532, a real monster OC. To the naked eye, it appears as a detached oval piece of Milky Way. In the telescope it was a tidal wave of bright stars. I rate this OC as the second most impressive object I saw in my telescope on this trip (after the Keyhole Nebula).

About 2 a.m. Crux, the Southern Cross, reached the meridian with Centaurus trailing behind it. Crux is the smallest of the 88 constellations and fits comfortably in the 8x50's 7 degree field. The Coal Sack adjacent to Crux was a conspicuous naked eye black hole. The Jewel Box cluster, NGC 4755, was smaller than I expected and required 60x to gain enough size to appreciate. To the east I eagerly awaited the rising of Omega Centauri, the sky's finest globular cluster. In the TV85 the cluster was much larger and brighter than M13, which I took time to compare with Omega. Resolution of Omega's outlying stars was soft due to its low height above the horizon (33 degrees). At 120x, the cluster filled the 1 degree field and resolution of its stars im-

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Neutrinos in Astronomy, Part Two

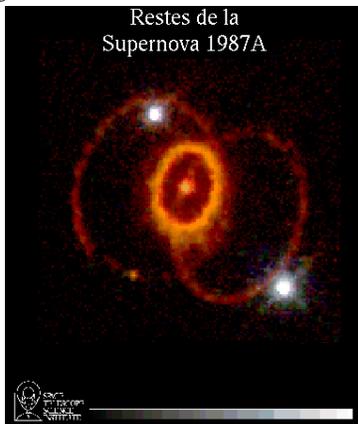
by Henry De Jonge IV

Supernovae Neutrinos

In this second installment we will look at neutrinos generated in SN and the CNB.

Neutrinos, (and antineutrinos) are emitted at various stages in a core collapse SN, beginning from the onset of collapse through the formation of the accretion disk. SN1987A was the first core collapse SN that we ever detected, (from 3 separate experiments) a predictable neutrino flux. It originated in the LMC and was classified as a type II SN. These neutrinos were the first specifically detected from outside our solar system, (and our galaxy). Below is an optical image of SN1987A.

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they travel. Astronomers are anxiously awaiting another SN in or near our galaxy to have the potential to detect more SN neutrinos.

This detection of neutrinos prior to the optical signals also meant that the neutrinos had mass and an upper limit was calculated by the well known solar neutrino theorist John Bahcall. This detection in 1987 of SN neutrinos founded the birth of SN neutrino astronomy and the results agreed with the theoretical models of SN Type II explosions.

During such SN when the iron core of a massive star collapses the implosion is reversed at nuclear densities when the nuclei break down into free nucleons, (halted by the strong nuclear force) and a neutron star, (or black hole later) begins to form. A bounce back shockwave is generated and driven into the supersonic in falling outer core. This bounce shock is stalled almost immediately due to neutrino losses, the pressure of the in falling mass, and the breaking down of nuclei into free nucleons across the shock. This can then create an accretion disk structure that is somewhat steady state. In fact during this one phase of neutrino production in these SN, the neutrinos are actually blocked by the collapsing core due to the extremely high density of infalling matter for a second or so before exploding outwards!

Where do these SN neutrinos come from? They come from reactions such as electron capture by protons, (forming neutrons and neutron star cores), electron-positron pair annihilation, radioactive decays, and several other processes throughout the SN episode. This detected flux from SN 1987A closed a major gap in SN theoretical models as it had been predicted that most of the energy in such SN comes streaming out as neutrinos. In fact only about 1% of the energy goes into the motion of the exploding star and

about 1/10,000 of the energy goes into the visible light show. This compact remnant of a core collapse SN is very hot after the first few seconds after collapse and neutrinos of all flavors are produced in very large numbers. The surrounding volume of space around this remnant is very optically dense and about 99% of the gravitational binding energy released by the collapse is carried away via neutrinos. It is estimated that about 10⁵⁸ neutrinos are released in such SN. In fact, if a neutron star is formed the rotation of the neutron star can also affect the neutrino luminosity, their average energy, and the energy levels of the neutrino species produced.

Part of the CNB is due to the abundance of relic SN neutrinos which have been produced by SN throughout the history of our universe. Thus neutrinos are made in vast numbers via SN and carry away huge amounts of energy. Yet despite this agreement of theory and experiment with the confirmation of SN neutrinos, we still do not have a complete understanding of SN explosions of any type.

Neutrinos and the Universe

The SM, (standard model) predicts that like the CMB photons, neutrinos should also have a cosmic background. These cosmic neutrino background, (CNB) neutrinos were produced in vast quantities in the early Universe, and since they rarely interact with matter there are still many of them about. They are the most abundant known particles in the universe, next to CMB photons, and yet are still completely undetected. The existence of this CNB was theoretically calculated shortly after the discovery of the CMB in the mid 1960's.

The CNB consists mainly of low energy relic neutrinos which decoupled, (dropped out of thermal equilibrium with other matter and radiation) from the cosmological fluid at a redshift of about 10¹⁰ or about 1 second after the BB (big bang), and are currently at a temperature of about 1.94 degrees K. These standard model neutrinos, (all 3 flavors) were tied to the electron content of the early Universe. Thus they are considerably older than the photons from the CMB which decoupled at about 400,000 years after the BB, or at a redshift of about 1100. These neutrinos carry a wealth of information about the formation of the early Universe and would complement the knowledge we get from the CMB. For comparison, relic gravitational waves are thought to be generated at about a redshift of 10²⁷ or 10-35 seconds after the BB. This mix of early neutrinos is calculated to be a mix of both relativistic and non relativistic neutrinos of all 3 flavors.

Another component of the CNB is also predicted to be a diffuse extra galactic MeV neutrino background generated from the integrated history of star formation which includes SN. This is especially strong due to the initial abundance of high massive stars early on in the Universe. Other CNB neutrinos come from proton-proton collisions in space. This overall flux of CNB neutrinos is predicted, (the range varies though) to be about 330 neutrinos per cubic centimeter with an amazingly low energy of about 0.0004 eV. Due to this extremely low energy of the relic CNB neutrinos, (much less than conventional experiments can detect) and the low probability of neutrino interaction in general,

Continued on page 4

Neutrinos in Astronomy, Part Two

Continued from page 3

it will be extremely difficult to detect these relic neutrinos.

Scientists are using the WMAP data in an attempt to analyze the CNB anisotropies by relating them to the anisotropies of the CMB. These anisotropies are caused by the gravitational influences of the CNB neutrinos. They are also incorporating galaxy clustering and SN distributions to help in this regard, as there is still a complete lack of direct physical CNB neutrino detection. Currently there is a fairly strong correlation, (95%) with the CMB data and the CNB data, as well as support from other cosmological evidence for the existence of the CNB.

Neutrinos are a prime candidate for a portion of DM. One undetected, strange type of theoretical DM candidate neutrino is called a sterile neutrino. They are a particular form of DM particle thought to exist from extensions of the SM and produced in the early universe via flavor oscillations. They may also be produced in core collapse SN explosions. These neutrinos have a theoretically predicted right handed spin where as the 3 main, (detected) neutrinos all have a left handed spin. This neutral neutrino does not take part in weak interactions and thus only feels the gravitational force. If they do exist they would add an immense number of neutrinos to the known approximations of existing neutrinos in the Universe. Sterile neutrinos can potentially behave either as hot, warm, or cold DM. Sterile neutrinos may also have had an effect on POP III stars (the first stars), via their very slow radioactive decay, (forming x-rays) by helping to ionize primordial gas, increasing its temperature, and thus enhancing such first star formation.

The best methods, (besides radioactive decay analysis) of determining upper limits on neutrino mass, (of all types including the sterile neutrino if they exist) will probably come from cosmology. Neutrinos acting as a form of DM are calculated to leave signatures in the CMB, weak lensing surveys, cosmic X-ray background, and large scale structure surveys. Their upper mass limits might also be calculated by examining the clustering of gas along the line of sight from distant quasars. Any gas density fluctuations detected may be related to small DM fluctuations which can in turn be correlated to neutrino induced fluctuations, (Lyman alpha forest constraints). Recently the analysis of the X-ray flux from M31 was used to calculate the upper mass for

a sterile neutrino. This is an area of ongoing research and debate.

By using the SM and both WMAP data and the SDSS, scientists have produced a model of what the CNB may look like, (see figure on this page).

In another twist regarding CNB neutrinos, the Copernican Principle states that we do not occupy any special place in our universe and it is usually taken for granted. There is some recent evidence and debate however that we may live in a slightly less dense portion of the known universe, (based upon SN data). The CNB could be used as a test to see if this is an accurate assumption, (provided of course that we have the ability to detect CNB neutrinos).

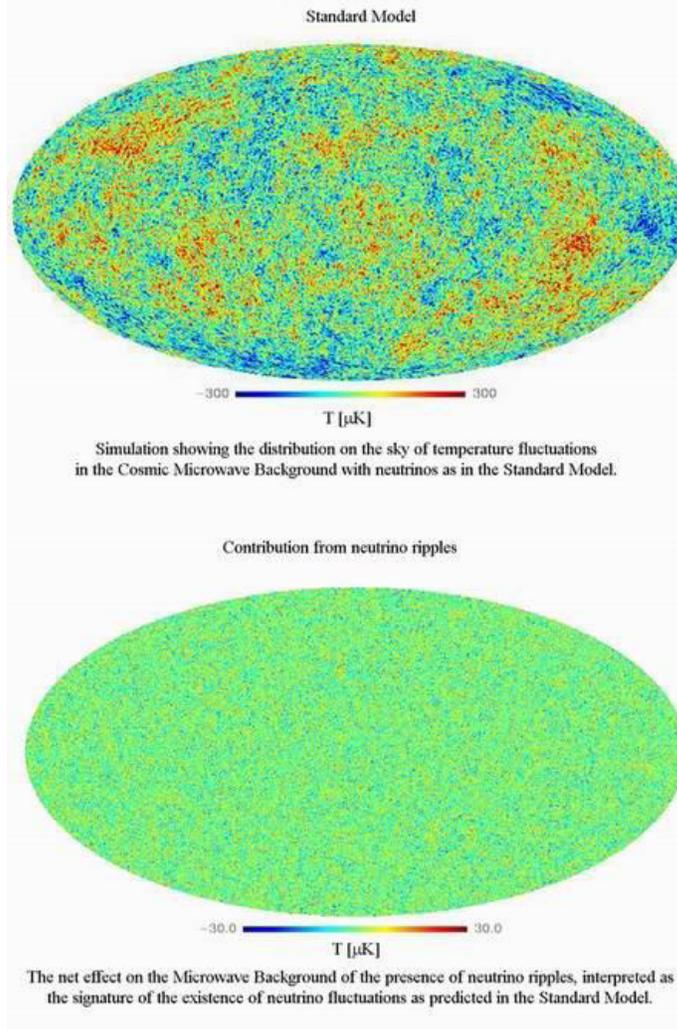
Any agreement with CNB theory will have to be strengthened in the future with experimental evidence. Despite their tiny mass, CNB numbers are so huge that they may contribute to the total mass of the Universe in a meaningful way.

It is hoped that in the future better measurements of the CMB along with data from such experiments as gravitational weak lensing studies, will enable more accurate CNB measurements and predictions. This could also help shed light on the mysteries of DM and DE.

Conclusions

We have seen that neutrinos, a fundamental particle in the SM, incredibly tiny, weakly interacting, and fast moving, play a large role in many astrophysical phenomena and may also give us unique and incredible insights into understanding such phenomena. They have caused us to modify the SM of matter and energy, while enabling us to greatly expand our knowledge of experimental and theoretical astrophysics. As of today there is still much to learn about neutrinos. We still do not know their absolute masses and only have upper bounds to their mass.

We have just begun to study and detect them in earnest and there are surely many more discoveries in the future regarding neutrinos. It is hoped that future Planck and DUNE, (weak gravitational lensing) data among other information, will be gathered to help us understand the role of neutrinos on a cosmic scale. My thoughts are that neutrinos will continue to surprise us and alter our understanding of the universe from the very small to the very large.



April Guest Speaker: Steve Desch

Steve Desch is an Assistant Professor in Astrophysics at Arizona State University's School of Earth and Space Exploration.

Steve is a theoretical astrophysicist by training, earning his PhD in Physics from the University of Illinois Urbana-Champaign in 1998.

His research centers around star and planet formation, specializing in applying meteoritic constraints to astrophysical models of protoplanetary disk evolution, and the converse, using astrophysical modeling to understand what happened to the components of meteorites. His other work includes star formation, including magnetohydrodynamic modeling of molecular cloud collapse, and work on showing the Sun formed in a high-mass star-forming region; protoplanetary disk evolution, including the magnetorotational instability and an updated minimum mass solar nebula; meteoritics, especially chondrule formation and the origin of the short-lived radionuclides; and planetary processes, including thermal evolution of Kuiper Belt Objects, and Martian dust devils.

Steve's topic for the April meeting is Cryovolcanism on Kuiper Belt Objects.



☾ FIRST QUARTER MOON ON APRIL 2 AT 07:34

● FULL MOON ON APRIL 9 AT 07:57

☾ LAST QUARTER MOON ON APRIL 17 AT 06:37

○ NEW MOON ON APRIL 24 AT 20:23

New EVAC Members in March

Ken & Amy Spruell, Chandler, AZ

Jonathan Yount, Gilbert, AZ

Classified Ads

Orion 8" F10 SCT & SkyView Pro Equatorial Mount

Standards include: XLT coatings, 24mm Plossl and manual for mount.

Extras include: Pro GoTo Upgrade Kit, v 3.20, firmware upgraded, cable and documentation manual for GoTo upgrade kit, polar axis finder and 12v battery. List price \$1999.00

This equipment is 18 months old. Used sparingly because 14.5" Dob gets preference. Reason for sale is to finance an upgrade.

Sale price \$1600.00

If you are interested in seeing this telescope contact AJ Crayon at 602-938-3277 or e-mail at acrayon@cox.net



Also, if you are thinking of a telescope for Christmas this is an ideal time to start looking and this is an ideal telescope to give.

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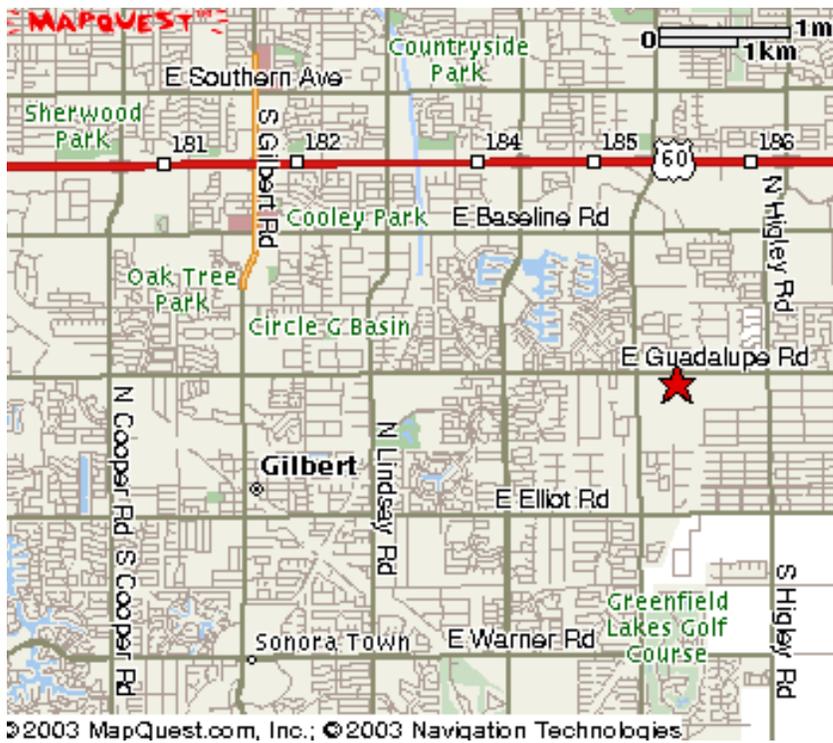
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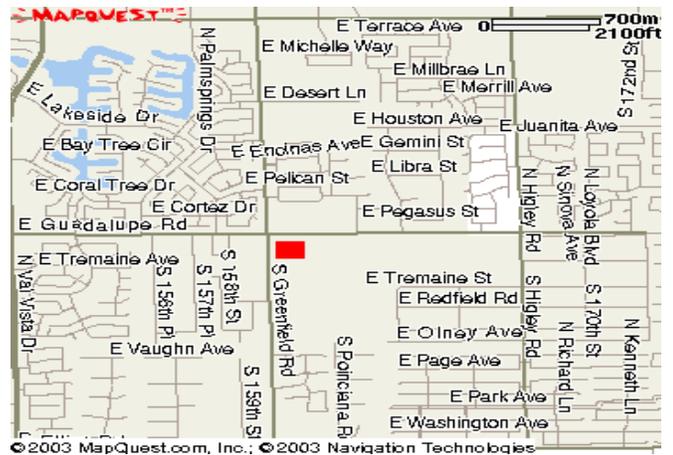


The monthly general meeting is your chance to find out what other club members are up to, learn about upcoming club events and listen to presentations by professional and well-known amateur astronomers.

Our meetings are held on the third Friday of each month at the Southeast Regional Library in Gilbert. The library is located at 775 N. Greenfield Road; on the southeast corner of Greenfield and Guadalupe Roads.

Meetings begin at 7:30 pm.

Visitors are always welcome!



Upcoming Meetings

April 17

May 15

June 19

July 17

August 21

September 18

Southeast Regional Library
775 N. Greenfield Road
Gilbert, Az. 85234

All are welcome to attend the pre-meeting dinner at 5:30 pm. We meet at Old Country Buffet, located at 1855 S. Stapley Drive in Mesa. The restaurant is in the plaza on the northeast corner of Stapley and Baseline Roads, just south of US60.

Old Country Buffet
1855 S. Stapley Drive
Mesa, Az. 85204

Likewise, all are invited to meet for coffee and more astro talk after the meeting at Denny's on Cooper (Stapley), between Baseline and Guadalupe Roads.

Denny's
1368 N. Cooper
Gilbert, Az. 85233



APRIL 2009

| Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
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| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | | |

April 2 - San Tan Elementary School Star Party

April 3 - Greenfield Elementary School Star Party

April 3 - MCC Open House

April 4 - 100 Hours of Astronomy Celebration

April 4 - Third Annual International Sidewalk Astronomy Night

April 10 - Public Star Party at Riparian Preserve in Gilbert

April 11 - IYA at Az Science Center

April 14 - Skyline Ranch School Star Party

April 17 - General Meeting at Southeast Regional Library in Gilbert

April 18 - Local Star Party at Boyce Thompson Arboretum

April 21 - Santa Rosa Elementary School Star Party

April 23 - Kyrene Akimel Middle School Star Party

April 25 - Deep Sky Star Party at Vekol Road

April 28 - EVAC School Star Party

MAY 2009

| Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
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| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | | | | | | |

May 1 - Butler School Star Party

May 2 - IYA at Az Science Center

May 8 - Public Star Party at Riparian Preserve in Gilbert

May 15 - General Meeting at SE Regional

Library in Gilbert

May 16 - Local Star Party at Boyce Thompson Arboretum

May 22 - RTMC starts

May 23 - Deep Sky Star Party at Vekol

East Valley Astronomy Club -- 2009 Membership Form

Please complete this form and return it to the club Treasurer at the next meeting or mail it to EVAC, PO Box 2202, Mesa, Az, 85214-2202. Please include a check or money order made payable to EVAC for the appropriate amount.

IMPORTANT: All memberships expire on December 31 of each year.

Select one of the following:

- New Member
 Renewal
 Change of Address

New Member Dues (dues are prorated, select according to the month you are joining the club):

- | | |
|---|---|
| <input type="checkbox"/> \$30.00 Individual January through March | <input type="checkbox"/> \$22.50 Individual April through June |
| <input type="checkbox"/> \$35.00 Family January through March | <input type="checkbox"/> \$26.25 Family April through June |
| <input type="checkbox"/> \$15.00 Individual July through September | <input type="checkbox"/> \$37.50 Individual October through December |
| <input type="checkbox"/> \$17.50 Family July through September | <input type="checkbox"/> \$43.75 Family October through December |
- Includes dues for the following year*

Renewal (current members only):

- \$30.00 Individual**
 \$35.00 Family

Magazine Subscriptions (include renewal notices):

- \$34.00** Astronomy
 \$33.00 Sky & Telescope

Name Badges:

- \$10.00** Each (including postage) Quantity: _____

Name to imprint: _____

Total amount enclosed:

Please make check or money order payable to EVAC

- Payment was remitted separately using PayPal
 Payment was remitted separately using my financial institution's online bill payment feature

Name:

Phone:

Address:

Email:

- Publish email address on website

City, State, Zip:

URL:

How would you like to receive your monthly newsletter? (choose one option):

- Electronic delivery (PDF) *Included with membership*
 US Mail **Please add \$10 to the total payment**

Areas of Interest (check all that apply):

- | | |
|--|---|
| <input type="checkbox"/> General Observing | <input type="checkbox"/> Cosmology |
| <input type="checkbox"/> Lunar Observing | <input type="checkbox"/> Telescope Making |
| <input type="checkbox"/> Planetary Observing | <input type="checkbox"/> Astrophotography |
| <input type="checkbox"/> Deep Sky Observing | <input type="checkbox"/> Other |

Please describe your astronomy equipment:

Would you be interested in attending a beginner's workshop? Yes No

How did you discover East Valley Astronomy Club?

PO Box 2202
Mesa, AZ 85214-2202
www.eastvalleyastronomy.org

All members are required to have a liability release form (waiver) on file. Please complete one and forward to the Treasurer with your membership application or renewal.

Liability Release Form

In consideration of attending any publicized Star Party hosted by the East Valley Astronomy Club (hereinafter referred to as "EVAC") I hereby affirm that I and my family agree to hold EVAC harmless from any claims, liabilities, losses, demands, causes of action, suits and expenses (including attorney fees), which may directly or indirectly be connected to EVAC and/or my presence on the premises of any EVAC Star Party and related areas.

I further agree to indemnify any party indicated above should such party suffer any claims, liabilities, losses, demands, causes of action, suits and expenses (including attorney fees), caused directly or indirectly by my negligent or intentional acts, or failure to act, or if such acts or failures to act are directly or indirectly caused by any person in my family or associates while participating in an EVAC Star Party.

My signature upon this form also indicates agreement and acceptance on behalf of all minor children (under 18 years of age) under my care in attendance.

EVAC only recognizes those who are members or invitees and who also have a signed Liability Release Form on file as participants at an EVAC Star Party.

Please print name here

Date



Please sign name here

**PO Box 2202
Mesa, AZ 85214-2202
www.eastvalleyastronomy.org**

Apollo Upgrade

The flight computer onboard the Lunar Excursion Module, which landed on the Moon during the Apollo program, had a whopping 4 kilobytes of RAM and a 74-kilobyte “hard drive.” In places, the craft’s outer skin was as thin as two sheets of aluminum foil.

It worked well enough for Apollo. Back then, astronauts needed to stay on the Moon for only a few days at a time. But when NASA once again sends people to the Moon starting around 2020, the plan will be much more ambitious—and the hardware is going to need a major upgrade.

“Doing all the things we want to do using systems from Apollo would be very risky and perhaps not even possible,” says Frank Peri, director of NASA’s Exploration Technology Development Program.

So the program is designing new, more capable hardware and software to meet the demands of NASA’s plan to return humans to the moon. Instead of staying for just a few days, astronauts will be living on the Moon’s surface for months on end. Protecting astronauts from harsh radiation at the Moon’s surface for such a long time will require much better radiation shielding than just a few layers of foil. And rather than relying on food and water brought from Earth and jettisoning urine and other wastes, new life support systems will be needed that can recycle as much water as possible, scrub carbon dioxide from the air without depending on disposable filters, and perhaps grow a steady supply of food—far more than Apollo life-support systems could handle.

Next-generation lunar explorers will perform a much wider variety of scientific research, so they’ll need vehicles that can carry them farther across the lunar surface. ETDP is building a new lunar rover that outclasses the Apollo-era moon buggy by carrying two astronauts in a pressurized cabin. “This vehicle is like our SUV for the Moon,” Peri says.

The Exploration Technology Development Program is also designing robots to help astronauts maintain their lunar outpost and perform science reconnaissance. Making the robots smart enough to take simple verbal orders from the astronauts and carry out their tasks semi-autonomously requires vastly more powerful computer brains than



The Chariot Lunar Truck is one idea for a vehicle equal to the lunar terrain. Each of the six wheels pivot in any direction, and two turrets allow the astronauts to rotate 360°.

those on Apollo; four kilobytes of RAM just won’t cut it.

The list goes on: New rockets to carry a larger lunar lander, spacesuits that can cope with abrasive moon dust, techniques for converting lunar soil into building materials or breathable oxygen. NASA’s ambitions for the Moon have been upgraded. By tapping into 21st century technology, this program will ensure that astronauts have the tools they need to turn those ambitions into reality.

Learn more about the Exploration Technology Development Program at www.nasa.gov/directorates/esmd/aboutesmd/acd/technology_dev.html. Kids can build their own Moon habitat at spaceplace.nasa.gov/en/kids/exploration/habitat.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

If It's Clear...

by *Fulton Wright, Jr.*

Prescott Astronomy Club

APRIL 2009

Shamelessly stolen information from Sky & Telescope magazine, Astronomy magazine, and anywhere else I can find info. When gauging distances, remember that the Moon is 1/2 a degree or 30 arc minutes in diameter. All times are Mountain Standard Time.

On Wednesday, April 1 (no fooling) the Moon is at first quarter and sets at 1:44 AM (Thursday). Actually first quarter happens at 7:34 AM Thursday (but we can't see it then), so the Moon tonight looks not quite 1st quarter and tomorrow looks a little past 1st quarter.

On Sunday, April 5, starting at 2:10 AM, you can see Saturn's brightest moon, Titan, enter Saturn's shadow. It takes about 20 minutes for the satellite to disappear.

On Thursday, April 9, the full Moon rises at 7:28 PM (31 minutes after sunset) spoiling any deep sky observing for the whole night. (This night the Moon is just past full, last night it wasn't quite full yet, the same situation as the first quarter phase on April 1 & 2.)

On Monday, April 13, from 12:21 AM to 4:35 AM (when Saturn sets), you will have your 4th of 10 chances to see Titan's shadow on Saturn. Use your best resolution telescope and catch it early while Saturn is high in the sky. Then move on to the next event of the night shown below.

On Monday, April 13, around 3 AM, you can watch the Moon occult a star cluster, M4. The bright limb of the Moon starts to cover the cluster about 2:40 AM. The center of the cluster is covered about 3:00 AM. You will want the biggest telescope you can get to see these fairly dim stars next to the bright Moon. About 3:50 AM the edge of the cluster starts to show near the dark limb. The center of the cluster comes out about 4:20 AM.

On Friday, April 17, at 1:42 AM, the third quarter Moon rises, allowing most of Thursday night for observing faint fuzzies.

From the Desk of the President

Continued from page 1

cial "Thank You!" to Randy Peterson for filling in for our scheduled speaker for March. Dr. Kim Hermann from Lowell Observatory notified us that she would be unable to attend due to illness, and Randy stepped in on short notice, and was able to make a fantastic presentation on "Asteroid Occupations". If you missed it, then you missed a good one. Hopefully, Randy can do it again sometime later. Steve Gifford also gave an interesting presentation during the "Show and Tell" session, by showing several image sequences which he made of comet Lulin.

April's presentation will be by Steve Desch, an Assistant Professor in Astrophysics with Arizona State University. He will be speaking on "Cryovolcanism on Kuiper Belt Objects". I will be truthful here..... I had to look that one up. Glad I did. This will be a very interesting presentation. As I mentioned at the March meeting, I continue to learn something new at every one of our functions. Mr. Desch maintains a web page, with lots of good background information. If you Google "Steve Desch" you will find him. And yes, I Googled "Cryovolcanism" and "Kuiper Belt Objects" also.

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On Tuesday, April 21, starting at 12:50 AM, you can see Saturn's brightest moon, Titan, enter Saturn's shadow. It takes about 20 minutes for the satellite to disappear.

On Wednesday, April 22, at dawn, you can see the Moon occult Venus. Although it won't be completely dark when it happens, the two thin crescents (the Moon 30 times bigger) should be a pretty sight in a small (3 inch) telescope just before Venus disappears behind the Moon. Here is the schedule of events:

4:14 AM The Moon and Venus rise above the east horizon.

4:19 AM Astronomical twilight begins (light first appears in the east).

4:51 AM Nautical twilight begins (constellations start to disappear).

5:10 AM the Moon covers Venus.

5:23 AM Civil twilight begins (bright stars start to disappear).

5:49 AM the Sun rises.

6:01 AM Venus reappears.

On Friday, April 24, it is new Moon, so you have all night to look for dim stuff.

On Sunday, April 26, about 4:00 AM, if you look at Jupiter low in the southeast, it will look as if it has 5 Galilean satellites. The extra one is 44 Capricorni. Can you tell which of the 5 it is?

On Sunday, April 26, about 8:00 PM, you can see Mercury at its best for the year. With binoculars look 10 degrees above the west-northwest horizon for the magnitude 0.4 planet. Notice that the Pleiades are just above the planet, and the thin crescent Moon is just above the cluster. You should be able to see Mercury anytime during the week surrounding the 26th.

On Tuesday, April 28, starting at 11:25 PM, you will have your 5th chance (of 10) of seeing Titan's shadow on Saturn. Saturn sets at 3:30 AM Wednesday with the shadow still on it.

One of the things that I really enjoy about this hobby is that fact that you can learn something new and interesting at every turn.

A special "Welcome" to our newly appointed Membership Chairman, Les Wagner. One of the things that Les will be doing, is contacting our new members, and extending a personal welcome to them. Everyone has a different reason for either "Joining" or "Belonging" to EVAC. Les will try and identify that reason, and offer any needed assistance to guide our new members to EVAC's extensive collection of information, and talented membership. Although EVAC has a vast array of information and experience, sometimes tapping into that assortment of knowledge can be challenging to a new member. Les can be contacted at membership@evaonline.org.

There are lots of events scheduled for early April, and I look forward to seeing everyone out there enjoying the skies, and sharing their "views" and thoughts with the public-at-large, and especially at the school events. Clear skies to all, and don't forget Keep Looking Up!



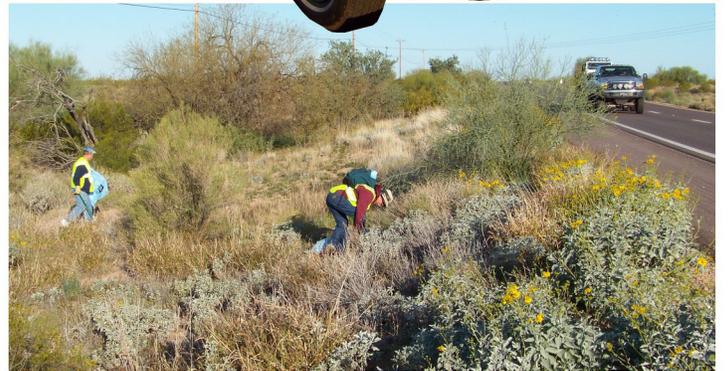
Gary Hobbs, David & Jan Douglass, Derek Youngson, Brooks Scofield, Ray Heinle, Donna Bader, Claude Haynes, Ron Risko, Bill Dellings, Peggy and Brad Crisler, Marty Pieczonka,

Adopt a Highway - March 7, 2009

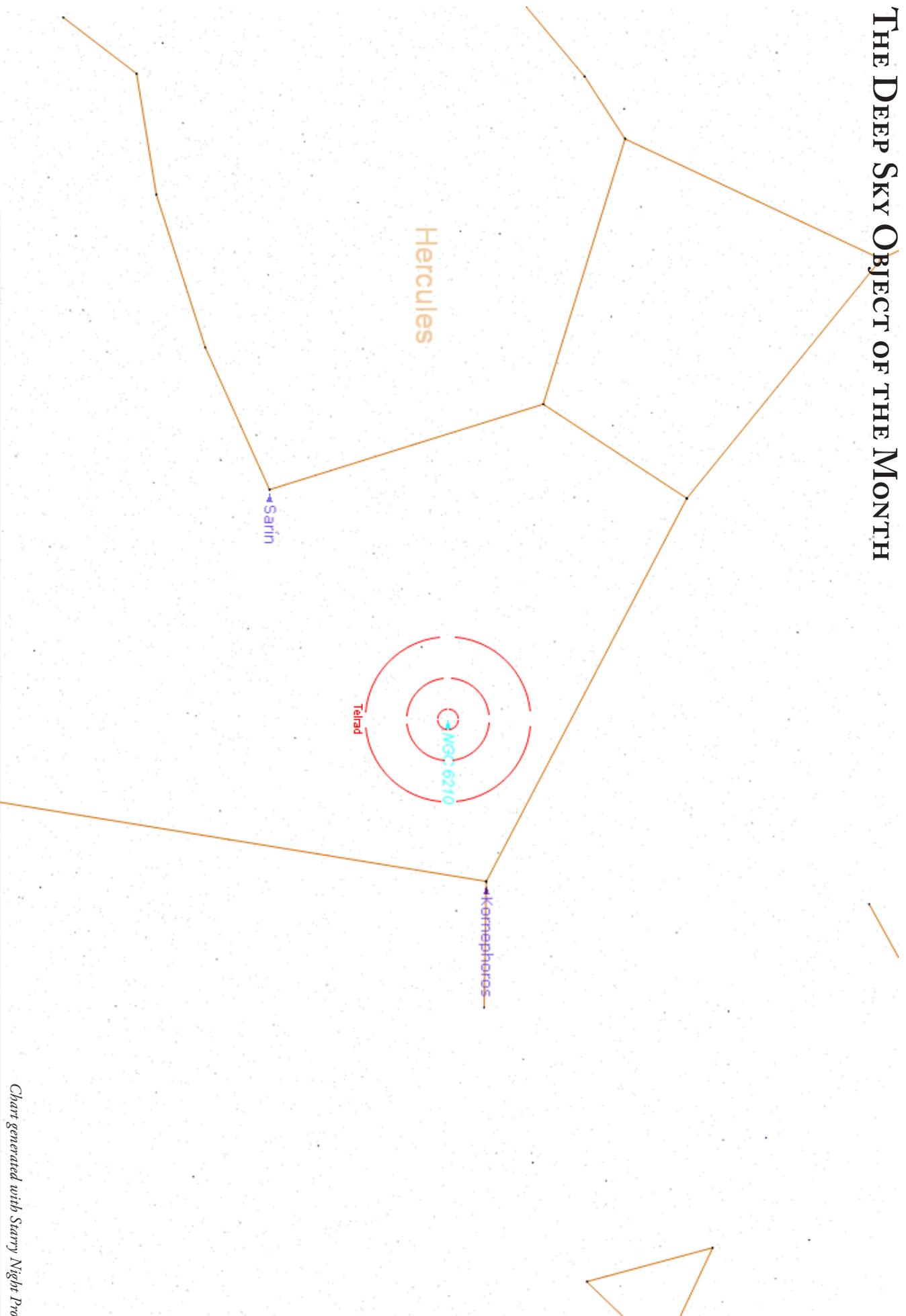
With 13 participants and a minimum amount of trash, we were soon back at Village Inn enjoying a delicious breakfast. The excitement for the day was a 50's Thunderbird and spring flowers



by Jan Douglass



THE DEEP SKY OBJECT OF THE MONTH



NGC 6210 (Turtle Nebula) Planetary Nebula in Hercules

RA 16h 44m 29.5s DEC +23° 47' 59" Magnitude: 9.3 Apparent Size: 16"

Chart generated with Starry Night Pro

The Backyard Astronomer

Continued from page 2 proved. Performance was compromised by Omega's low altitude and my modest aperture (85mm = 3.3"). So I went over to Gary's 12.75" and bummed a look at Omega Centauri in his scope. Oh yeah, much better! Resolution to the core without averted vision – nice! I really wanted to split Alpha Centauri but due to its low altitude, my TV85, normally a killer on doubles, just couldn't seem to get the job done. Finally, when it reached culmination on the meridian at 4 a.m. and was only 19 degrees above the horizon, I managed to split this magnitude 0.1, 1.2, 13.3" double at 120x. Victory was sweet. It had been a long time since I spied this star's duality (I think low altitude and tropic seeing made a normally easy double difficult to split).

Other notes: Gemini and Auriga were upside-down in the north. Polaris was only 10 degrees above the northern horizon – disconcerting! I felt my world had tipped over. It was not unusual to see Howler monkeys and iguanas roaming



The observing field in front of the rooms

the grounds. The place is a birder's paradise. We saw many new, colorful birds. The White-Throated Magpie-Jays were especially fond of dive bombing the dinner table and taking off with a portion of your meal! A boat excursion to a mangrove forest and a tractor-towed wagon trip through the 800 acre property were included in the tour – both were unique and enjoyable. Many participants in the group were repeat customers and the camaraderie was quite evident among them. I see why they keep coming back. I miss the place already, especially that hammock.

Back in San Jose at the Marriott Hotel on our last morning before leaving, I glanced out my east facing room on the 4th floor and in the breaking dawn sky observed Jupiter, Mars, and Mercury in conjunction. I smiled to myself and thought what an appropriate sight to end an enchanting astronomical week.



Lora and Bill at the TV85



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Keep Looking Up!

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